International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 6 Issue 10, October 2019

ISSN: 2394-4404

An Evaluation Of The Effects Of Local Climates On The Horticultural Improvement Techniques Of Mangifera Indica (L) In A Dry-Land Ecosystem Of Nigeria

Salami, A.O.

Forestry Research Institute of Nigeria, Federal College of Forestry, Jos, Plateau State-Nigeria

Dalibi, J.H.

Department of Geography, Faculty of Humanities, Management and Social Sciences, Federal University of Kashere, Kashere, Gombe State-Nigeria

Abstract: ***Nursery experiments were conducted on Mangifera indica during the wet seasons for 4 years. The aim was to device a suitable horticultural improvement method through grafting and budding techniques on the plant species suitable for the arid and semi-arid regions of Nigeria, in view of the harsh climatic conditions. A treatment was undertaken each year amounting to 4 treatments, using 1000 seedling stocks per treatment. Treatment 1 were those seedlings side grafted without any control on weather vagaries as well as without irrigation but rain fed, while Treatment 2 were the plants that were patch budded with the same condition as Treatment 1. Treatment 3 were seedlings top grafted, covered and tied up with "Santana leather," just below the graft region, thereby creating a micro climate condition for each grafted seedling independently, but grafting operations and "taken" processes not completed before the terminal rain; while Treatment 4 were exposed to the same condition as Treatment 3, but the exercise and 'taken' period completed before the terminal rain. The experiments were kept under close observation each year, and appropriate records duly taken. "Taken" periods commenced especially on the grafted plants after the 10th day. Simple percentages were used for statistical analysis, while 4, 2, 83.3 and 99 percentages were recorded for Treatments 1, 2, 3 and 4 respectively. Mangoes could be grafted in the arid and semi-arid regions of Nigeria at other times of the year and with other methods; but cheaper, easier, and economical using top grafting with poly-cap method, when the exercise is completed before the terminal rain. This method appraises the creation of micro-climate condition for each plant under grafting independently.***

Keywords: ***weather, micro-climate, terminal rain, taken, economical.***

I. INTRODUCTION

Mangifera indica (L) is one of the notable edible fruits of the tropical forest, having high nutrition and economic values. It is an evergreen plant with dense crown commonly planted as shade and commercial trees. It is in the family anacardiaceae (Garner, *et al*, 1976; Morton, 1987; Keay, 1989; Salami, 2005_a). The genus comprises well over 62 species, and more than a dozen of these produce edible fruits (Popenoe, 1920; Garner, *et al*, 1976; Salami, $2005_{a;}$ Shah, *et al*, 2010). Mangoes are grown extensively and well distributed throughout the world. It is one of the most desirable and most admired fruit trees of the tropics and sub-tropics (Salami, 2005_a; Salami, 2005_b; Orwa, *et al*, 2009). It is cultivated on an area of approximately 3.7 million ha worldwide, and conquers the second position as a tropical crop in terms of production (Masud Parvez, 2016).

M. indica is widely cultivated for commercial fruit production, a garden tree, and as shade trees in many tropical and subtropical regions of the world (Bally, 2006). Fruits are eaten and dispersed by bats, hornbills, monkeys, elephants, raccoons, porcupines, and humans (Bally, 2006; Orwa, *et al*, 2009). Currently, the plant *M. indica* is included in the Global Compendium of Weeds (Randall, 2012), and is also listed as invasive in Singapore, Namibia, South Africa, Brazil, Costa Rica, the Galápagos Islands, Puerto Rico, Virgin Islands,

Antigua, Australia and on many islands in the Pacific Ocean; including among others like Hawaii, Easter Island and French Polynesia (Chong, *et al*, 2009; PIER, 2014).

The improved varieties commonly called "budded" or "grafted" mangoes had made an acclaimed domestic trade name, especially in Nigeria (Salami, 2005_a). The specific name "indica" indicates its origin, and it had being in cultivation in India for over 4,000 years (Ochse, 1931; Salami, 2005_b). The plant had received great attention in Indo-Pakistan sub-continent, where many horticultural varieties of high nutritional standards have developed (Purseglore, 1972; Salami, 2005_a). Apart from India, the plant species are also grown in countries such as Pakistan, Sri Lanka, Burma, Bangladesh, Thailand, Philippines, Malaysia, Indonesia, Vietnam, China, Australia, Israel, Mexico, Kenya, Tanzania, Egypt, South Africa, and Nigeria among others (Purseglore, 1972; Morton, 1987; Arogba, 1997; Orwa, *et al*, 2009).

Leaves of *Mangifera indica* are dark green, glossy and elongated lanceolate. Fruits are up to 15cm long, yellow or reddish when ripe, with smooth skin, yellowish flesh and large flattened fibrous seed. The flowers are in conspicuous upright terminal panicles, and the fruit hang down in clusters (Keay, 1989). The plants also thrive under a wide range of climatic conditions, but profitable cultivation and success in horticultural improvement exercise are limited by temperature and precipitation (Sigh, *et al*, 1963; Salami, 2005_b; Morton, 1987; Orwa *et al*, 2009).

In the process of propagation for improved varieties, the root stock, the scion and their moisture contents plays very significant roles. This explain why the selection of a suitable root stock is as important as that of the scion varieties itself (Salami, 2005_b). The root stock also has a very strong influence on the growth and longevity of the grafted tree, its yield, fruit quality, time of ripening, disease and infection, pest resistance, as well as adaptability to soil and soil moisture conditions (Sigh, *et al*, 1963; Garner, *et al*. 1976; Salami, 2005_a; Salami, 2005_b). Moreover, the plant grows in areas with scanty rainfall and also in very wet regions (Waqas Ahmed, *et al*, 2012). However, 890–1016mm rainfall, well distributed; is considered for a successful cultivation (Popenoe, 1920; Chandler 1958; Garner, *et al*, 1976; Morton, 1987; Salami, 2005_a). It is adopted to withstand period of prolonged drought due to its deep and well developed tap root system, but requiring irrigation at the early stage of development (Garner, *et al*, 1976; Salami, 2005_a; Morton, 1987; Orwa, *et al*, 2009). The plant supports profound apicultural practice, but excessive rainfall hampers bees' activities on the plant, dilutes the stigmatic secretion and dampens or washes away the pollens, thereby resulting in low fruit set. Moreover, relatively dry weather during flowering is more ideal (Garner, *et al*, 1976; Salami 2005_a; Orwa, *et al*, 2009).

Mangifera indica is more desirable, cultivated, marketed, and patronized in northern Nigeria than the southern parts of the country, and it is well eaten by both young and old (Salami, 2005_a). In view of this, several vegetative methods towards its improvement and conservation had been adopted, especially in the arid and semi arid regions of the country. Among these are ground and air layering, budding, stem propagation, side grafting, green house propagation, use of incubators, top grafting and other scientific methods in line with the demonstration in Kotur (2012) analysis. This resulted in the production of good horticultural hybrids such as Alvanso, Mabroka, Peter, Tommy, Peach, Kent, Julie, etc, which are very nutritious, fleshy, and succulent (Salami, 2005_a). Preservation methods are however lacking in the country, as mango fruits are only available in Nigeria during the "flush" period. More so, the Nigerian Stored Products Research Institute (NSPRI) was currently engaged in the design of several equipments for its storage for potential use (NSPRI, 2008).

Mangoes are also an important component of diets in many less developed countries of the tropics and subtropics, as their attractions and flavours have enhanced the quality of life in regions of the world that have experienced low living standards and serious nutritional deficiencies, having a wide range of its product values available all over the world (Bally, 2006, Orwa, *et al*, 2009). Several industrial products from *M. indica* are as well available in cans, sachets, cartons, bottles and plastics in Nigeria from Fuman Industries Limited, Dangote Group, Bua Group, Murtala Nyako Farms and SUMAL Industries Limited to mention but a few (Salami, 2005_a Salami, 2005_b).

Approximately 1% of mango production is processed for juice, nectars, preserves (including chutney), fruit leather, dried fruit slices, and frozen pulp; as well as flavours for baked goods, ice cream, yoghurt, etc., as no part of the fruit is wasted. In India and the sub-continent, the seed is used for extraction of starch 'amchur', and the peels (skin) have been used as a source of anacardic acid (Timsina and Kilingar 2015). Mango wood is a low quality timber, and the bark of the tree is an important source of tannins for curing leather (Arogba, 1997). The fruits and seeds also have some medicinal characteristics (Bally, 2006; Orwa, *et al*, 2009; Waqas Ahmed, *et al*, 2012; Masud Parvez, 2016). Nonetheless, the plant is beneficial through its leaves, bark and roots for pot herbs and industrial/pharmaceutical raw materials; while the plantation makes a good apiculture (Salami, 2005_b; Barreto, *et al*, 2008). Generally, like any other evergreen plants, it is useful as cover against soil erosion, excessive evapotransipration and direct solar radiation effects. It also has a high quality fuel wood for energy, while its biomass and remains are good for soil nutrition and recycling process as contained in Yahaya and Salami (2008) reports.

The general objective of this study is to device a suitable horticultural improvement technique for massive production of *Mangifera indica* varieties that would be capable of setting fruits within short time frame in the arid and semi-arid regions of Nigeria, despite the harsh climate of the region. The specific objectives are to: (1) Conduct grafting exercises on the plant. (2) Conduct budding exercise on the plant. (3) Assess the effects of moisture contents of plants stocks and scion used towards the success of the exercise. (4) Proffer a cheap method of micro-climate creation and analyze its effects on the exercise. (5) Evaluate the effects of rainfall and irrigation on the exercise. (6) Analyze the data for results and decision making and (7) make appropriate recommendations based on the findings of the study for public consumption.

II. MATERIALS AND METHODS

Mango trees and seedlings used for this experiment were obtained within Kano State. The seedlings were well taken care off to leaf flush, appropriate stem maturity and adequate moisture content development levels. They were about a year old in the nursery before the exercise at each experimental treatment level (period) to ensure sustainability of budding and grafting operations.

PLANT STOCKS, SCION AND THEIR PREPARATION

The primary plant upon which budding/grafting exercise was performed is called the stock (Salami, 2005_a). Healthy plants with good moisture contents were used for this purpose. Scion is the nodal part of a green plant stem or a terminal shoot prepared and cut for budding or grafting exercise respectively (Salami, 2005_b). Except for scion meant for patch budding, scion for grafting purpose were prepared and left on the mother tree for between 7-10 days prior to the exercise. This preparation entails stripping off the leaves from the body of green, matured but not tender or old stems, at least 20cm length from the terminal bud. Reasons for this are as follows:

- ✓ Reduction of evapotranspiration to conserve moisture.
- ✓ Concentration and retention of hormone to aid genetic transfer between the stock and the scion.
- ✓ Enhancement of shooting which preludes leaf formation, to commence right from the mother tree.

For patch budding, mother trees with good moisture contents were selected for scion production.

EXPERIMENTAL DESIGN AND PROCEDURE

The experiments were carried out running across 4 years during the wet season. The first year (T_1) witnessed the preparation of 1000 seedlings of *Mangifera indica* for side grafting. Weather vagaries as well as irrigation were however not under control at this treatment level, as they were all tendered under normal atmospheric and weather conditions. A total of 1000 seedlings were then used the second year for patch budding, (T_2), and were exposed to the same condition in respect of weather and irrigation as in Treatment 1 (T_1). Seedling stocks totaling 1000 were also used in the 3rd year of the experiment (T_3). They were grafted in 3 batches in the months of July, August, and September when they were sure to posses enough moisture contents visible from their formation, physical appearance and through incision, as applied to other treatments. Incision entails a trial cut on the stocks stem. It is usually soft and peels easily if it possesses enough moisture content (Salami, 2005_b). Moreover, a transparent polythene cap of 15cm x 26cm size (Santana leather) were used to cover the scion from the upper part of the stock and tied upward so as to create a micro-climate condition for each plant independently within the graft region, plate 1. This prevents unfavourable exposure to adverse climatic conditions in the course of regeneration. The 4th year as well witnessed top grafting with polythene cap in same dimension as in Treatment 3. A total of 1000 seedlings were also used at this treatment level, but with the grafting and regeneration process completed before the terminal rain.

The experiments were put under shade to prevent high evapotranspiration. They were also subjected to close observation each year throughout the experimental period, and appropriate records duly taken on daily basis. Furthermore, polythene caps were removed from successful plants starting from the 10th day when leaf formations were observed.

III. RESULTS AND DISCUSSION

The results of this investigation showed gross variations, table I, fig. I. Several methods of vegetative propagation and horticultural improvement methods are available for the production of improved varieties of *M. indica*, but which however have limited applications at various ecological settings due to climatic variations (Salami, 2005_a).

Seedlings of *Mangifera indica* that were side grafted without a control on the weather conditions and irrigation supplements (T_1) had 4% propagation success. See table I. Similarly, seedling stocks of the plant species that were patch budded and treated

Plate 1: Mangifera indica grafting stocks under a cheap micro climate condition – Top grafting with polycap method

s/n	Treatment	No of stock	Percentage success
1	Seedlings that were side grafted with no control on weather vagaries and irrigation.	1000	4
2	Seedlings that were patch budded with no control on weather vagaries and irrigation.	1000	2
3	Seedlings that were top grafted, covered with "Santana leather", but operations not completed before the terminal rain.	1000	83.3
4	Seedlings that were	1000	99

	top grafted, covered with "Santana leather", but the exercise, and 'taken' period completed before the terminal rain.		

Table I: Percentage propagation success of Mangifera indica in a 4 year experimental study using various techniques

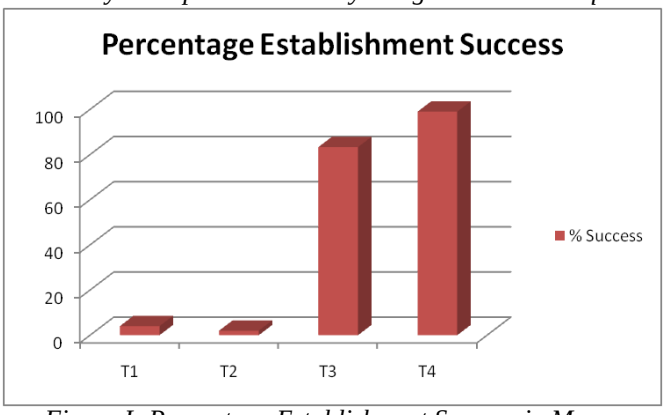

Figure I: Percentage Establishment Success in Mango Improvement Trials over 4 Years

In the same way as Treatment I (T_2) also recorded 2% success. The massive failure in the above two treatment levels suggests the absence of neither irrigation nor weather control as the primary cause. This is because insufficient moisture contents ensued within the plant materials under observation, coupled with lack of irrigation after the rains. This aggravated excessive evapotranspiration and dwindling experimental output in view of the climatic conditions of the study area. Moreover, Sigh, *et al*, (1963); Salami, (2005$_b$); Kotur (2012) further reiterated that profitable cultivation is limited by temperature and precipitation. Same time, the reports of Garner, *et al*, (1976); Salami, (2005$_a$); Orwa, *et al*, (2009) also stipulated that proper irrigation is necessary at the early stages of the plants development. Salami, (2005$_b$) also gave out in support with the fact that exposure of the plants species to various uncontrolled harsh climatic conditions during the process of genetic transfer between the stock and the scion leads to grafting and budding failure as witnessed in this experiment.

In Treatment 3, where the mango seedlings were top grafted in 3 batches of 30:30:40 ratios, alongside with the months of July, August, and September. They were also caped with polythene sheets. Results indicated that 100% each were recorded in the months of July and August, which were stable months of rainfall in the study area. It was 50% success recorded in the month of September before the terminal rainfall which occurred at the end of the second week, as the mean temperature range was already getting to 42.63^{0}C, table II. Total results for this treatment was however 83.3% (See Table I).

In like terms, seedlings that were top grafted in same conditions as Treatment 3, but had grafting activities and regeneration processes completed before the terminal rain (Treatment 4) had 99% success (see Table I). The stoppage in the regeneration processes in Treatment 3 at the 3rd month which coincides with the termination of rainfall, and the profound success recorded in both Treatments 3 and 4, amounting to 83.3 and 99% respectively were largely due to temperature and precipitation effects, which are prominent climatic factors in the course of plant propagation. Even though, a mean monthly rainfall of 3.51mm, 9.98mm, and 12.57mm were recorded in the months of July, August and September respectively (See Table II), but were not evenly distributed across the months to the end of September. This observation is however attributed also to the downward change in the success course of the experiment from the month of September when the rain stopped, leading subsequently to an immediate upsurge in the atmospheric temperature in the study area, having minimum temperature of 19^{0}C and maximum temperature of 37^{0}C (see Table II). This is supported by Sigh *et al*, (1963); Garner *et al*, (1976); Salami (2005a) and Salami (2005$_b$) reports.

IV. CONCLUSION

Mangoes are grafted and budded in the arid and semi-arid regions (the dry-lands) of Nigeria at other times of the year apart from the rainy season, but not very economical. The exercise is however more reliable and profitable in the rains. Moreover, horticultural improvement and establishment techniques on the plant species using top grafting with polycap method, upon which the exercise is completed before the terminal rain is an effective way towards its improvement in these zones for effective results, where irrigation and its associated costs are not relevant. The polythene cappage do create a micro-climate condition within the graft region for each plant independently, thereby giving protection to the delicate fusion of the two specimens being joined together. It is faster, cheaper, and more reliable than the use of green house, mechanical or electrical incubators, and propagators for micro-climate creation. It is also limited in technical handling to a common layman for effective utilization. It is hereby established that moisture contents levels of both the scion and the stocks meant for grafting exercise plays very major roles in the operational success for the plants varietal

Month	Rain fall in mm	Temperature in ^{0}C			Relative Humidity in %			Wind Speed in Km/hr			Sunshine in Hr.		
	Mean	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
January	0	14	12	6	12.9	11.1	15.2	102	50.2	159.2	6.7	3.2	11.5
February	0	35.7	12	40	14.55	10.5	17.7	112.9	31.86	142.9	9.31	4.6	11.3
March	0	36.4	16	43	17.1	12	25.9	73.4	32.1	175.3	7.5	6.4	10.8
April	0.6	40.3	21	44	23	17.7	26.5	93.26	44.26	161.05	8.2	3.8	11.4
May	2.02	25.4	22	42	25.1	17.7	26.5	93.26	44.26	161.05	8.2	3.8	11.4
June	6.0	34	18	38	22.9	23.2	30.5	119.6	54.8	162.3	17.4	6.5	12.1
July	3.51	32.3	19	35	23	20	24.7	101.4	16.8	167.1	11.18	1.1	11.7
August	9.98	31	19	34	23.02	20.2	24.5	61.8	20	118.2	N.A	N.A	11.7
September	12.57	42.63	19	37	23.92	22	32.5	49.75	17.46	73.69	7.29	2.5	18.0
October	0	37.32	17	39	21.23	17.3	24	51.15	13.88	109.96	8.95	2.2	11.1
November	0	73.9	10	24	17.43	14.1	23	48.19	25.94	69.27	17.43	15.1	23
December	0	32.23	11	36	14.35	10.2	16.9	54.43	23.9	118.2	N.A	N.A	N.A

NA: Not Available

Source: Kano State Agricultural and Rural Development Authority (KNARDA).

Table II: Metrological data for the year 2017 in Kano

improvement. The control of weather vagaries is also established as a major factor of success on the grafting exercise in the region under focus.

V. RECOMMENDATIONS

The application of the result of this exercise is a good hedge way towards massive production of the *Mangifera indica* plant species, as well as boosting its varietal propagation for local consumption, industrial raw materials and for foreign markets; as the application is easy to handle, even by lay men. It is hereby strongly recommended for use in the arid and semi-arid regions of the country and the front-line beyond.

REFERENCES

[1] Arogba, S.S. (1997): Physical, chemical and functional properties of Nigerian Mango (Mangifera indica) kernel and its processed flour. Journal of the Science of Food and Agriculture, 73(3):321-328.
[2] Bally, I.S.E. (2006): Mangifera indica (Mango). Ver. 3.1. Species Profiles for Pacific Islands Agroforestry [ed. by Elevitch, C. R.]. Hawaii, USA: Permanent Agriculture Resources (PAR). Retrieved April, 2019.
[3] Barreto J.C.; Trevisan, M.T.S.; Hull, W.E.; Erben, G.; De Brito, E.S.; Pfundstein, B.; Würtele, G.; Spiegelhalder, B.; Owen, R.W. (2008): Characterization and quantitation of polyphenolic compounds in bark, kernel, leaves, and peel of mango (Mangifera indica L.). Journal of Agricultural and Food Chemistry. 56 (14): 5599–5610. doi:10.1021/jf800738r. PMID 18558692. Retrvd. April, 2019.
[4] Chandler, W.H. (1958): Evergreen Orchards. (2nd eds.), Lea and Fabiger, Philade. Pp 51.
[5] Chong, K.Y., Tan, H.T.W., Corlett and R.T., (2009): A checklist of the total vascular plant flora of Singapore: native, naturalised and cultivated species. National University of Singapore, Singapore: Raffles Museum of Biodiversity Research, 273 pp. Retrieved April, 2019.
[6] Garner, et al, (1976): The Propagation of Tropical Fruit Trees. CAB International, in: Salami, A.O. (2005a): Special Case Studies on Mangifera indica: Horticultural Improvement and Establishment Technique in the Arid and Semi-arid Zones of Nigeria. A Paper Presented at a Workshop Organized by Audu Bako College of Agriculture, Dambatta–Kano, for Participants on Self Reliance Training Programme of Shekarau Administration in Kano State. May 24th.
[7] Keay, R.W.J. (1989): Trees of Nigeria. Clarendon Press, Oxford. Pp. 366.
[8] Kotur, S.C. (2012): Effect of paclobutrazol application on nutrient dynamics, vigour and fruit yield in 'Alphonso' mango (M. indica L.), J. of Hort. Sc., 7 (2):134-137.
[9] Masud Parvez, G.M. (2016): Pharmacological Activities of Mango (Mangifera indica): A Review. Journal of Pharmacognosy and Phytochemistry 5 (3): 01-07
[10] Morton J, 1987. Mango. In: Fruits of Warm Climates [ed. by Morton, J.]. Miami, USA: Echo Point Books & Media, 221-239. Retrieved April, 2019.
[11] NSPRI (2008): Pamphlet distributed during a workshop for FRIN scientist on renewable natural plant resources organized by ASCAS Integrated Agricultural Concepts Ltd. from 21st -26th May in Kano – Nigeria.
[12] Ochse, J.J. (1931): Fruits and Fruit Culture in Dutch East Indies. G. Kolf and Co. Batavia English Education. Pp. 31.
[13] Orwa, C; Mutua, A; Kindt, R; Jamnadass, R and Simons, A. (2009): Agroforestree Database: a tree reference and selection guide version 4.0. World Agroforestry Centre. http://www.worldagroforestry.org/af/treedb/. Retrieved April, 2019.
[14] PIER (2014): Pacific Islands Ecosystems at Risk. Honolulu, USA: HEAR, University of Hawaii. http://www.hear.org/pier/index.html. Retrieved April, 2019.
[15] Popenoe, W. (!920): Manual of Tropical Crops. Longman, Green, London, pp. 47.
[16] Randall, R.P. (2012): A Global Compendium of Weeds. Perth, Australia: Department of Agriculture and Food Western Australia, 1124 pp. Retrieved April, 2019. http://www.cabi.org/isc/FullTextPDF/2013/20133109119.pdf.
[17] Salami, A.O. (2005a): Special Case Studies on Mangifera indica: Horticultural
[18] Improvement and Establishment Technique in the Arid and Semi-arid Zones of Nigeria. A Paper Presented at a Workshop Organized by Audu Bako College of Agriculture, Dambatta–Kano, for Participants on Self Reliance Training Programme of Shekarau Administration in Kano State. May 24th.
[19] Salami, A.O. (2005b): Technical Process of Vegetative propagation of Mangifera indica. A Paper Presented in a Workshop Organized by National Directorate of Employment (NDE), Hadejia Road, Kano for Participants on Private Nursery Establishment Training Programme – June 15th.
[20] Shah, K.A.; Patel, M.B.; Patel, R.J.; Parmar, P.K. (2010): Mangifera Indica (Mango). Pharmacognosy Reviews. 4 (7): 42–48. doi:10.4103/0973-7847.65325. PMC 3249901. PMID 22228940. Retrieved April, 2019.
[21] Sigh, et al, (1963): Fruit Culture in India. Indian Council of Agricultural Research, New Delhi, in: Salami, A.O. (2005b): Technical Process of Vegetative propagation of Mangifera indica. A Paper Presented in a Workshop Organized by National Directorate of Employment (NDE), Hadejia Road, Kano for Participants on Private Nursery Establishment Training Programme – June 15th.
[22] Timsina, B. and Kilingar, N. (2015): Mango seeds: A potential source for the isolation of bioactive compounds with anti-cancer activity. International Journal of Pharmacy and Pharmaceutical Science. 7 (3):89-95.
[23] Waqas Ahmed, Tahir, F.M., Rajwana, I.A., Raza, S.A., Asad, H.U. (2012): Comparative evaluation of plant growth regulators for preventing premature fruit drop and improving fruit quality parameters in 'Dusehri' mango., Int. J. of Fruit Science, 12 (4):372-389-

ISSN: 2394-4404

http://www.tandfonline.com/loi/wsfr20. Retrieved, April, 2019.

[24] Yahaya, S.U. and Salami, A.O. (2008): An evaluation of pre-treatment on the germination of Tamarindus indica. Obeche Journal. Vol. 26 (2), pp.53-58.